

PROTON IRRADIATION ON MATERIALS

by

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ABSTRACT

A computer code is developed by utilizing a radiation transport code developed at NASA Langley Research Center to study the proton radiation effects on materials which have potential application in NASA's future space missions.

The code covers the proton energy from 0.01 Mev to 100 Gev and is sufficient for energetic protons encountered in both low earth and geosynchronous orbits. With some modification, the code can be extended for particles heavier than proton as the radiation source.

The code is capable of calculating the range, stopping power, exit energy, energy deposition coefficients, dose and cumulative dose along the path of the proton in a target material. The target material can be any combination of the elements with atomic number ranging from 1 to 92, or any compound with known chemical composition. The generated cross section for a material is stored and is reused in future to save computer time.

This information can be utilized to calculate the proton dose a material would receive in an orbit when the radiation environment is known. It can also be used to determine, in the laboratory, the parameters such as beam current of proton and irradiation time to attain the desired dosage for accelerated ground testing of any material.

It is hoped that the present work be extended to include polymeric and composite materials which are prime candidates for use as coating, electronic components and structure building. It is also desirable to determine, for ground testing these materials, the laboratory parameters in order to simulate the dose they would receive in space environments.

A sample print-out for water subject to 1.5 Mev proton is included as a reference.

WATER

ATOMIC NUMBERS = 1.000 8.000 0.000 0.000 0.000

STOICHIOMETRIC COEFFICIENTS = 2.000 1.000 0.000 0.000 0.000

ATOMIC DENSITIES, ATOMS/GM = 0.669E+23 0.334E+23 0.000E+00 0.000E+00 0.000E+00

TARGET THICKNESS, MIL; DENSITY, G/CM3 = 0.400E+01 1.000

RANGE OF PROTON IN G/CM2 & MIL; ENERGY, MEV = 0.454E-02 0.179E+01 1.500

ONE PROTON PER CM2 ON TARGET

DISTANCE MIL	STOP. PWR MEV/G/CM2	PROTON E MEV	DOSE MEV	CUMM DOSE MEV	DOSE RAD	CUMM DOSE RAD
0.000E+00	0.196E+03	0.150E+01	0.505E-01	0.505E-01	0.796E-07	0.796E-07
0.100E+00	0.201E+03	0.145E+01	0.518E-01	0.102E+00	0.816E-07	0.806E-07
0.200E+00	0.207E+03	0.140E+01	0.533E-01	0.156E+00	0.839E-07	0.817E-07
0.300E+00	0.213E+03	0.134E+01	0.549E-01	0.210E+00	0.864E-07	0.829E-07
0.400E+00	0.219E+03	0.129E+01	0.566E-01	0.267E+00	0.892E-07	0.841E-07
0.500E+00	0.227E+03	0.123E+01	0.586E-01	0.326E+00	0.924E-07	0.855E-07
0.600E+00	0.235E+03	0.117E+01	0.609E-01	0.387E+00	0.959E-07	0.870E-07
0.700E+00	0.245E+03	0.111E+01	0.635E-01	0.450E+00	0.100E-06	0.886E-07
0.800E+00	0.256E+03	0.104E+01	0.666E-01	0.517E+00	0.105E-06	0.904E-07
0.900E+00	0.269E+03	0.977E+00	0.702E-01	0.587E+00	0.111E-06	0.925E-07
0.100E+01	0.284E+03	0.906E+00	0.744E-01	0.661E+00	0.117E-06	0.947E-07
0.110E+01	0.302E+03	0.832E+00	0.793E-01	0.741E+00	0.125E-06	0.972E-07
0.120E+01	0.323E+03	0.753E+00	0.854E-01	0.826E+00	0.135E-06	0.100E-06